FMH II 01
ESO 885
AGDEX 822

FARM DRAINAGE ECOMONICS

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Farm operators seldom question the value of farm drainage. Farmers quickly enumerate the advantages such as: improved yields, timeliness of all field operations, including harvesting; elimination of wet areas, improved soil tilth, and the reduced worry of not getting a crop planted or harvested. Effects of poor drainage are easily visible even to the untrained eye when long periods of excessive rainfall reduce plant growth or kill crops in some spots in the field.

Surface drainage and tile drainage are two methods of removing excess water. Drainage in some years is the determining factor in crop yield or in fact whether or not there is a yield. Research has also shown that corn yields from tile drained land have less than one-half the yield variation (21%) from year to year when compared to undrained or surface drained-only land which has a 50% yield variation from year to year. A lower yield variation means less economic risk.

Some nearly level, poorly drained, Ohio soils can benefit from a combination of tile and surface drainage. Research indicates expected yield increases from 0-10% are possible from a combination of tile and surface drainage compared to tile only yields. Depending on field conditions, soil type, topography and similar factors it may be unnecessary to install a surface drainage system throughout the entire field. Land smoothing and/or leveling coupled with regular maintenance is the key to successful operation of the surface drainage system. Maintenance of tile systems is also important to reap maximum benefits.

How much economic advantage results from drainage? Since there is a considerable difference in cost of installation of surface and tile drainage systems, let's take a look at the economic advantage of yield increases to a farmer investing in drainage. An analysis of drainage investments for both the owner-operator and absentee landlord is developed in the following tables and material. The cost of drainage is quite variable. It depends on the availability of an outlet, the soil type, the number and size of rock, the size and shape of fields, the topography of the farm, the price of the materials and installation plus many other factors. Drainage costs also vary from one section of Ohio to another, reflecting many of the above factors. For the purpose of this discussion, investment costs were based on current average costs for surface drainage and tile in North Central Ohio in 1981. Surface drainage costs were assumed to be $60.00 per acre and tile drainage cost at $500.00. Average outlet costs were also included.

Tile life varies depending on the type of material, maintenance level and soil type where installed. Annual costs for both 20 and 25 year useful life are reviewed.

TAX ADVANTAGES

Surface drainage is eligible for a deduction as a conservation expense (up to 25% of gross income from farming) in the year of installation. Installation costs may be fully recovered in the year of installation. Surface drainage, when amortized is usually spread over a 20 year period. Table 1 outlines the annual costs of tile and surface drainage. Interest was calculated at 14% of the mid-value of the investment. In the following calculations, investment cost for tile was considered to be $450.00 due to a deduction of 10% investment tax credit. ($500.00 total installation cost minus $50.00 investment tax credit = $450.00 net investment.) Maintenance was calculated at 4% of total installation cost per year for surface drainage and 0.2% of total installment cost per year for tile.

Table 1. Estimate Of Annual Drainage Costs Based On Useful Life Concept - North Central Ohio 1981.

Cost Items	Annual Drainage Costs		
	Tile		Surface
	20 Yr. Useful Life	25 Yr. Useful Life	
Annual Useful Life Cost	$25.00	$20.00	____*
Interest (14% of mid-value)	31.50	31.50	____*
Maintenance	1.00	1.00	$2.40
Total Annual Cost	$57.50	$52.50	$2.40

Assumptions:
Tile installed cost per acre = $500.00
Surface Drainage installation cost per acre = $60.00
Interest rate = 14%
Investment cost for tile in interest calculation = Installed cost minus 10% investment credit tax ($500.00 - $50.00 = $450.00).
Maintenance - surface drainage 4% of installed cost per year.
- tile drainage 0.2% of installed cost per year.

*Treated as conservation expense with full cost deducted in year of installation. (Annual limit of 25% of gross income from farming. Excess treated as carry-over.)

INCREASED YIELDS

Research has shown significant yield responses occurring from drainage improvement. Yield response will vary depending on several factors and from farm to farm. Table 2 attempts to show various levels of yield response by corn, soybeans and wheat. The farmer knowing his specific situation and current yields, can estimate the percent yield response due to drainage and determine possible bushels per acre increase.

Expected yield increases are not shown for crops like tomatoes, cucumbers, cabbage, sugarbeets, small fruits and other specialty crops. The yield increases and returns from these crops could be expected to be as great or greater than crops shown in the tables. In a "wet" year, increases from higher value crops will go a long way toward paying the entire cost of the drainage improvement. Comparing the annual costs outlined in Table 1 with the price of higher value crops, one can estimate the amount of yield increase needed to pay for drainage.

Table 3 outlines the average annual increase in dollar returns per acre for several common crop rotations based upon several increased yield response levels for surface and tile drainage. Increased returns were calculated using $3.10 per bushel for corn, $7.30 per bushel for soybeans, and $3.90 per bushel for wheat.

SUBSTANTIAL RETURNS ON INVESTMENT

Since tax laws permit surface drainage costs to be recovered as a conservation expense in the year of installation, Table 3 indicates that a 30% or higher yield increase will cover the installation cost in one year. After investment cost is recovered, annual costs are limited to maintenance while continuing to enjoy increased returns.

An economic analysis of tile drainage is shown in Table 4. Only tile drainage is analyzed in detail since the original investment cost is higher and the investment must be recovered over time. Economic calculations in Table 4 are based on a useful life of 20 years with the investment cost spread over this 20 year period (Table 1). Calculations considering only current tax law and accelerated depreciation schedules result in slightly different results and will be mentioned later. Annual costs (as assumed in this example) are compared to the average annual returns from five cropping sequences (Table 3). The annual return above annual costs for owner-operator and 50-50 landlord share are outlined in Table 4. Percent return on investment was calculated by dividing the investment cost ($450.00) into the sum of annual return above cost and the annual interest charge ($31.50) calculated in Table 1. The interest charge must be added back because it had already been deducted as a cost in determining return above cost.

CONSIDERATIONS WHEN LAND IS LEASED

Since the owner-operator receives all the benefits from drainage, this analysis indicates he can expect a good rate of return from this investment. Tax savings can add to the owner-operator's returns.

The economics of drainage become more complicated for the landlord who is receiving only a portion of the crop. Usually the 50-50 landlord pays for all of the drainage but must pay for this investment with only one-half of the yield increase. Table 4 indicates that the landlord's 50% share of increased returns will not cover the estimated annual costs until the 60% yield increase level is achieved.

Tenants of rented farms often request improved drainage. Owners understandably resist such sizeable investments. A major reason for resisting the investment is the low return on investment compared to alternative opportunity returns. Good arguments can be made by both the tenant and the landowner. Work on a well drained farm can be done more timely and a good tenant can be kept or acquired with good drainage. A common statement made by tenants is "I work that farm last because of poor drainage."

ARRANGEMENTS WITH TENANTS

Landowners who resist investment costs in drainage systems may be willing to negotiate with the "good" tenant. A long term lease with special allowances to assure the tenant recovery of his cost through increased returns may be a potential for negotiations. The tenant may request some method of determining compensation if for some reason the long term lease must be broken.

Table 2. Expected Yield Increases Resulting From Installation Of Surface Drainage And Tile Drainage Compared To Yields From Undrained Land At Selected Percentage Improvements In Yield[1/]

Crop	Yield Potential Undrained Soils Bu./A.	SURFACE DRAINAGE Additional Yield (Bu./A.)[2/] at Selected Percentage Yield Increases				TILE DRAINAGE Additional Yield (Bu./A.) at Selected Percentage Yield Increases				SURFACE PLUS TILE DRAINAGE Additional Yield (Bu./A.) at Selected Percentage Yield Increases				
		20%	30%	40%	50%	30%	40%	50%	60%	40%	50%	60%	70%	80%
Corn	0 - 70	14	21	28	35	21	28	35	42	28	35	42	49	56
Soybeans	0 - 25	5	7.5	10	12.5	7.5	10	12.5	15	10	12.5	15	17.5	20
Wheat	0 - 25	5	7.5	10	12.5	7.5	10	12.5	15	10	12.5	15	17.5	20

1/Yield increases from drainage improvements vary depending on soil type, soil tilth, topography, maintenance of system, and other management factors. Potential yield increases are within the parameters of findings in drainage research conducted at OARDC, North Central Branch, Erie County, 1967-1979 and unpublished data from analysis of crop yield improvements using different drainage systems in Wood County 1965-67.

2/Additional yield calculations based on undrained soil yields: corn-70 bu. per acre; soybeans-25 bu. per acre; and wheat-25 bu. per acre.

Table 3. Expected Value Of Additional Annual Gross Receipts Per Acre Over No Drainage For Selected Common Rotations And Yield Increase Levels By Drainage System[1/]

Cropping Sequence	SURFACE DRAINAGE Percent Yield Increase				TILE DRAINAGE Percent Yield Increase				SURFACE PLUS TILE DRAINAGE Percent Yield Increase				
	20%	30%	40%	50%	30%	40%	50%	60%	40%	50%	60%	70%	80%
Continuous Corn	$43.40	$65.10	$86.80	$108.50	$65.10	$86.80	$108.50	$130.20	$86.80	$108.50	$130.20	$151.90	$173.6
C-C-B (Soybeans)	41.13	61.65	82.20	102.75	61.65	82.20	102.75	123.30	82.20	102.75	123.30	143,85	164,4
C-C-C-B	41.67	62.51	83.35	104.19	62.51	83.35	104.19	125.03	83.35	104.19	125,03	145,86	166,7
C-C-B-W (Wheat)	35.70	53.61	71.40	89.25	53.61	71.40	89.25	107.10	71.40	89.25	107.10	124.95	142.8
C-C-C-B-W	37.24	55.86	74.48	93.10	55.86	74.48	93.10	111.90	74.48	93.10	111.90	130.34	148.9
Average Annual Returns From Five Cropping Sequences	$39.83	$59.75	$79.65	$ 99.56	$59.75	$79.65	$ 99.56	$119.51	$79.65	$ 99.56	$119,51	$139,38	$159.2

1/Calculations based on yield increases assumed in Table 2 and crop prices outlined in text.

Table 4. Economic Analysis - Annual Cost, Returns And Profitability Of Tile Drainage Systems For Two Methods Of Land Tenure and Four Levels of Yield Increase.

	Owner-Operator				Owner - 50% Share			
	Percent Increase In Yield				Percent Increase In Yield			
	30%	40%	50%	60%	30%	40%	50%	60%
Increased Returns	$59.75	$79.65	$99.56	$119.51	$29.86	$39.86	$49.78	$59.76
Annual Cost (see Table 1)	57.50	57.50	57.50	57.50	57.50	57.50	57.50	57.50
Return Above Cost	2.25	22.15	42.06	62.01	-27.64	-17.64	-7.72	2.26
Percent Return On Investment ($450.00)	7.5%	11.9%	16.3%	20.8%	.86%	3.1%	5.3%	7.5%

Table 5. Twenty Year Economic Analysis And Net After Tax Cash Flow Considering Annual Costs, Additional Income, And Income Tax Associated With Tile Drainage Installation.

Year	Depreciation[1] Accelerated Cost Recovery System	Interest ($500.00, 10 year repayment, 14% Interest)	Annual Expense Deduction[2]	Additional Income[3]	Balance - Additional Income minus Expenses	Income Tax[4]	Net After Tax Cash Flow[5]
1	$ 45.00	$70.00	$116.00	$80.00	$-36.00	$ (9.36)	$138.36[6]
2	110.00	63.00	174.00	80.00	-94.00	(24.40)	103.40
3	105.00	56.00	162.00	80.00	-82.00	(21.32)	100.32
4	105.00	49.00	155.00	80.00	-75.00	(19.50)	98.50
5	105.00	42.00	148.00	80.00	-68.00	(17.68)	96.68
6	--	35.00	36.00	80.00	44.00	11.44	67.56
7	--	28.00	29.00	80.00	51.00	13.26	65.74
8	--	21.00	22.00	80.00	58.00	15.08	63.92
9	--	14.00	15.00	80.00	65.00	16.91	62.09
10	--	7.00	8.00	80.00	72.00	18.72	60.28
11-20	--	--	1.00	80.00	79.00	20.54	58.46

1/Under 1981 Tax Law changes tile is eligible for a 5 year recovery period using the Accelerated Cost Recovery System (ACRS) Schedule of 15%, 22%, 21%, 21%, and 21% depreciation in years 1 through 5.
2/Includes $1.00 annual cash maintenance charge.
3/Average Additional income as indicated in Table 3 at the 40% increased yield level.
4/Numbers in parantheses indicate tax savings in years 1 through 5 when deductions exceed taxable income. (26% tax bracket assumed.)
5/ Additional income minus income tax and annual maintenance.
6/Includes $50.00 Investment Tax Credit ($500.00 x .10 = $50.00).

DEPRECIATION AND INVESTMENT CREDIT OPPORTUNITIES

Tax law changes in the Economic Recovery Act of 1981 liberalize depreciation and investment credit opportunities for the taxpayer. Tile is classified as 5-year property and is eligible for either the Accelerated Cost Recovery System 5-year depreciation method or 5, 12, or 25-year straight line depreciation treatment. Due to these changes (effective for 1981) it is possible to recover tile depreciation costs much more rapidly than in the past. Table 5 outlines some of the financial considerations using the most rapid depreciation currently possible. The analysis includes the Accelerated Cost Recovery System depreciation schedule, borrowed funds, 40% yield increase, annual maintenance cost and 26% income tax bracket. Note, during the first five years annual expenses exceed added income resulting in an income tax savings. The net after tax cash flow indicated in Table 5 is available to cover interest and the $50.00 annual principal payment. It is evident that the net cash flow will not cover these payments in most years until year 10. This deficit totals $34.43 for years one through nine and must be made up from other sources of income. If,on the other hand, fewer funds or no funds were borrowed for the tile investment, the taxpayer is in a higher tax bracket, or higher yield levels were assumed the net cash flow picture would be even more favorable. If one calculates the payback period using an accepted payback formula which ignores interest cost and depreciation (payback = investment divided by additional income minus variable cost) the payback period is 6.33 years. After investment costs are recovered income benefits continue with only a small annual maintenance expense.

INCREASED LAND VALUE

Another factor often discussed with drainage is the effect on the sale price of the land. The effect of installed drainage on land price will vary depending on the purpose for which purchased land is intended. Recent sales have indicated potential buyers are willing to offer more for well tiled land. The potential buyer is aware that any drainage costs involved will add to the effective purchase price. This also has two advantages to the seller who has invested in tile: 1) he can recover his investment and 2) some amount of income has been converted from ordinary taxation to capital gains taxation.

SUMMARY

In summary, crop production involves considerable financial risk. Good management practices reduce risk factors. Poor drainage is one factor which can negate most other recommended management or cultural practices. A farm operator must take a close look at drainage as it affects his operation if he expects to achieve the returns associated with good management.

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Issued in furtherance of Cooperative Extensive Work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Roy M. Kottman, Director of the Cooperative Extension Service, The Ohio State University. 1/82